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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/816,958	04/05/2004	Yukio Takigawa	042323	2429
38834	7590	12/14/2006	EXAMINER	
WESTERMAN, HATTORI, DANIELS & ADRIAN, LLP 1250 CONNECTICUT AVENUE, NW SUITE 700 WASHINGTON, DC 20036			LE, DUNG ANH	
			ART UNIT	PAPER NUMBER
			2818	

DATE MAILED: 12/14/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

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<b>Office Action Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>	
	10/816,958	TAKIGAWA ET AL.	
	<b>Examiner</b>	<b>Art Unit</b>	
	DUNG A. LE	2818	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 08 November 2006.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-15 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-15 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 05 April 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                                | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                       | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

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#### DETAILED ACTION

Applicant's request for reconsideration of the finality of the rejection of the last Office actions (12/12/2005, 4/17/2006 and 8/8/2006) are persuasive and, therefore, the finality of that action are withdrawn.

Applicant's amendment (10/19/2005) necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

**Claim Rejections**

***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

**Claims 1-2 and 11 are rejected under 35 USC 102 (e) as being anticipated by**

**Regarding claim 1**, Sun teaches a method for fabricating a semiconductor device comprising the steps of:

forming an opening in a insulation film 303; forming an interconnection layer 302 of Cu [ [0011] as a main material in the opening (especially refer to Fig. 3G and refer to related texts); and

concurrently spraying nitrogen gas and water on the surface of the interconnection layer 302 buried in the opening (by using the applicator 52 in fig. 2) ([0039]-[0040], page 6, claim 1,7).

**Regarding claim 2**, further comprising, after the step of concurrently spraying the nitrogen gas and the water, the step of forming a diffusion preventing film 314 (fig. 3H and refer to related texts) for preventing the diffusion of the Cu on the insulation film and the interconnection layer.

**Regarding claim 11**, wherein in the step of concurrently spraying the nitrogen gas and the water, the water to be concurrently injected with the nitrogen gas is carbonated water or ozonized water [0044].

### **Claim Rejections - 35 USC § 103**

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**Claims 3, 8-9, 12 and 13 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Sun et al. in view of Ngo et al. (6472755).**

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Sun teaches the claimed invention as applied to claims 1-2, including the diffusion preventing film 314 except the step of forming the diffusion preventing film is an SiC film or a silicon nitride film as cited in current claim.

Ngo teaches the diffusion preventing film 50 is an SiC film or a silicon nitride film (col 6, line 48-55).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to recognize the advantage and desirability to modify Sun 's method by form the diffusion preventing film is an SiC film or a silicon nitride film in order to provide a high quality, high reliability for the diffusion preventing layer .

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form the diffusion preventing film is an SiC film or a silicon nitride film is commonly used to prevent undesirable or detrimental reactions in the contact region, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the desired application.

**Regarding claim 8**, wherein in the step of forming the opening, the opening containing a via hole and an interconnection trench formed in a region containing the via hole is formed (Ngo, figs. 2-3 and refer to related texts).

**Regarding claim 9.** (Original) A method for fabricating a semiconductor device according to claim 3, wherein in the step of forming the opening, the opening containing a via hole and an interconnection trench formed in a region containing the via hole is formed (Ngo, figs. 2-3 and refer to related texts).

**Regarding claim 12,** wherein in the step of concurrently spraying the nitrogen gas and the water, the water to be concurrently injected with the nitrogen gas is carbonated water or ozonized water (Ngo, col7, lins 5-10).

**Regarding claim 13,** wherein in the step of concurrently spraying the nitrogen gas and the water, the water to be concurrently injected with the nitrogen gas is carbonated water or ozonized water (Ngo, col7, lins 5-10).

**Claims 7 and 15 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Sun et al. in view of the following remark.**

**Regarding claim 7,** Sun et al. disclose the claimed invention as applied to claim 1 except for the step of forming the opening, the opening containing a via hole and an interconnection trench formed in a region containing the via hole is formed.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form the opening, the opening containing a via hole and an interconnection trench formed in a region containing the via hole is formed, this feature is commonly used to create the interconnect in the surrounding contact regions, since it has

been held to be within the general skill of a worker in the art to select a known feature on the basis of its suitability for the practical use.

**Regarding claim 15**, wherein in the step of concurrently spraying the nitrogen gas and the water, the water to be concurrently injected with the nitrogen gas is carbonated water or ozonized water (Sun, [0044]).

**Claims 5- 6 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Sun et al. in view of Ngo and further in view of Li et al. (2004/0219795 A1).**

**Regarding claim 5**, Sun and Ngo et al. discloses the claimed invention as applied to claims 1- 2, except for the step of applying hydrogen plasmas to the surface of the insulation film and the surface of the interconnection layer.

Li et al. teach the step of applying hydrogen plasmas 38 to the surface of the insulation film 28 and the surface of the interconnection layer 36 (fig. 3, [0053]).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to applying hydrogen plasmas to the surface of the insulation film and the surface of the interconnection layer in Ngo's method, in order to improve the performance of the low-k dielectric or over which the copper interconnect has been created by increasing the breakdown voltage of the low-k dielectric, resulting in improved Time Dependent Dielectric Breakdown (TDDB), removed the layer of CuO or Cu.sub.2O from the surface of a created copper interconnect,



reduced the dielectric constant of the low-k dielectric in or over which the copper interconnect has been created by removing carbon from the low-k dielectric and by thereby making the low-k dielectric more porous, and prevented damage to the surface of the low-k dielectric in or over which the copper interconnect has been created. ([0055]-[0058]).

**Regarding claim 6**, Sun and Ngo et al. disclose the claimed invention as applied to claims 1-2, and 3 except for the step of applying hydrogen plasmas to the surface of the insulation film and the surface of the interconnection layer.

Li et al. teach the step of applying hydrogen plasmas 38 to the surface of the insulation film 28 and the surface of the interconnection layer 36 (fig. 3, [0053]).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to applying hydrogen plasmas 38 to the surface of the insulation film and the surface of the interconnection layer in Ngo's method, in order to improve the performance of the low-k dielectric in or over which the copper interconnect has been created by increasing the breakdown voltage of the low-k dielectric, resulting in improved Time Dependent Dielectric Breakdown (TDDB), removed the layer of CuO or Cu.sub.2O from the surface of a created copper interconnect, reduced the dielectric constant of the low-k dielectric in or over which the copper interconnect has been created by removing carbon from the low-k dielectric and by thereby making the low-k dielectric more porous, and prevented damage to the surface of the low-k dielectric in or over which the copper interconnect has been created. ([0055]-[0058]).

**Claims 4, 10 and 14 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Sun et al. in view of Li et al. (2004/0219795 A1).**

**Regarding claim 4,** Sun et al. disclose the claimed invention as applied to claim 1, except for the step of applying hydrogen plasmas to the surface of the insulation film and the surface of the interconnection layer.

Li et al. teach the step of applying hydrogen plasmas 38 to the surface of the insulation film 28 and the surface of the interconnection layer 36 (fig. 3, [0053]).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to applying hydrogen plasmas 38 to the surface of the insulation film and the surface of the interconnection layer in Ngo's method, in order to improve the performance of the low-k dielectric in or over which the copper interconnect has been created by increasing the breakdown voltage of the low-k dielectric, resulting in improved Time Dependent Dielectric Breakdown (TDDB), removed the layer of CuO or Cu.sub.2O from the surface of a create copper interconnect, reduced the dielectric constant of the low-k dielectric in or over which the copper interconnect has been created by removing carbon from the low-k dielectric and by thereby making the low-k dielectric more porous, and prevented damage to the surface of the low-k dielectric in or over which the copper interconnect has been created. ([0055]-[0058]).

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**Regarding claim 10**, Sun et al. in view of Li et al. disclose the claimed invention as applied to claims 1 and 4, except for the step of forming the opening, the opening containing a via hole and an interconnection trench formed in a region containing the via hole is formed.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form the opening, the opening containing a via hole and an interconnection trench formed in a region containing the via hole is formed, this feature is commonly used to create the interconnect in the surrounding contact regions, since it has been held to be within the general skill of a worker in the art to select a known feature on the basis of its suitability for the practical use.

**Regarding claim 14**, step of concurrently spraying the nitrogen gas and the water, the water to be concurrently injected with the nitrogen gas is carbonated water or ozonized water (Sun, [0044]).


### **Conclusion**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dung A. Le whose telephone number is (571) 272-1784. The examiner can normally be reached on Monday-Tuesday and Thursday 6:00am- 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, M. Smith can be reached on (571) 272-1907. The central fax phone numbers for the organization where this application or proceeding is assigned are (571)272-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

DUNG A. LE   
Primary Examiner  
Art Unit 2818